The Value of the Right Competence

Fabrizio Sara
The MathWorks Italy
Managing Director

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It is expected, that by 2022, 27% of available jobs will be in roles that don't yet exist.

- Boston Consulting Group

Agenda

- A look to the future
  Megatrends

- MathWorks
  How do we respond to Megatrends
  - Modeling and Simulation
    Model Based Design, capture intellectual property
  - The engineering Platform for AI
    Artifcial Intelligence in The MathWorks

- Opportunities
  Where to invest to align with the emerging trends

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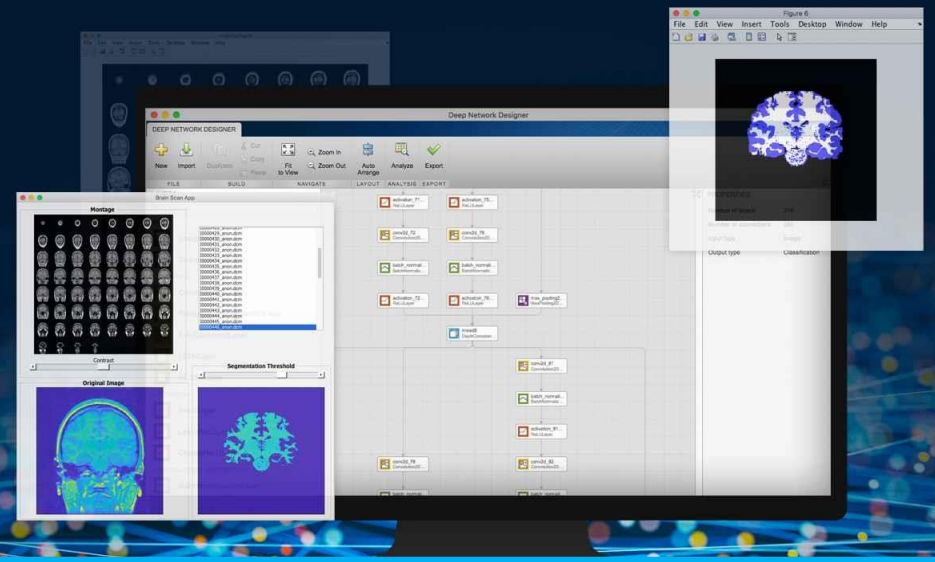
MATLAB® & SIMULINK®



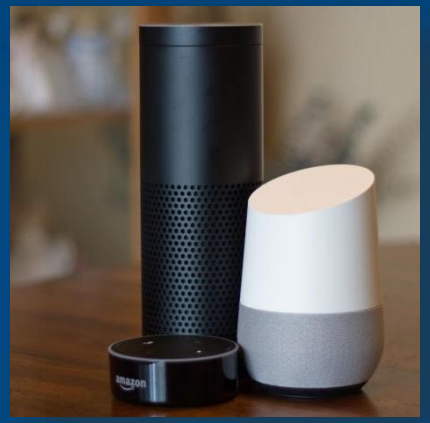
A look to the future

MathWorks®

1

Algorithms and Software in Everything

- Smart devices
- New machines
- All university departments, not just computer science



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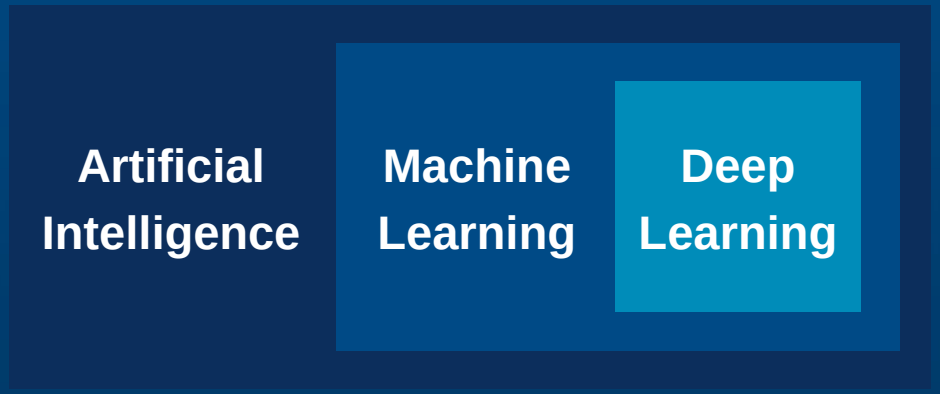
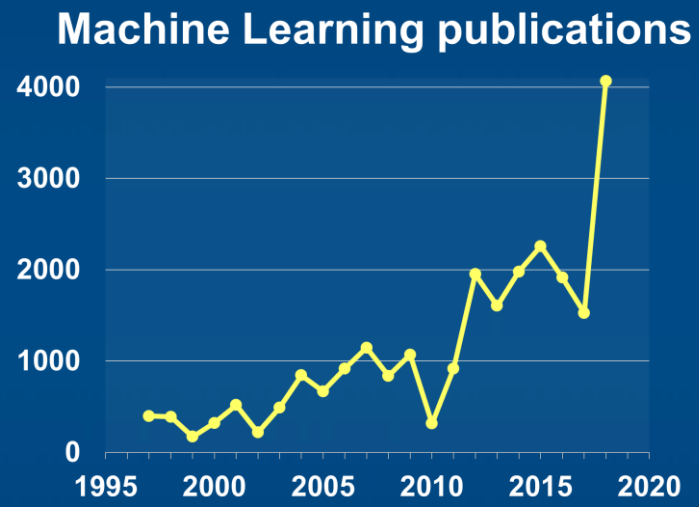
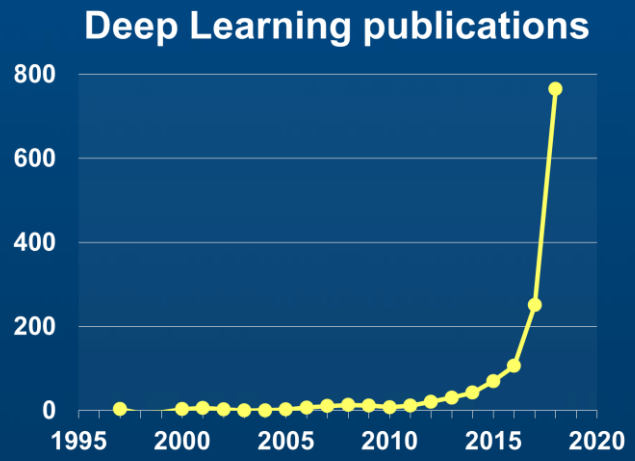
2

Artificial Intelligence (AI)

- Machine Learning
- Deep Learning







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3

Autonomous Systems

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4

Digital Transformation

Companies

- "Last-mile" connection to their customers
  - "Sensors", telemetry, usage data
- Software in everything
- Data science
- AI (Machine and Deep Learning)
- Industry 4.0

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5

Rise of Cloud Platforms

- Amazon Web Services, Microsoft Azure
- Containerization, orchestration
- Software processes migrating into engineering and science
  - Agile
  - Repos
  - Continuous integration

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6

Electrification of Everything

- Transportation
- Shift from Internal Combustion Engine only to Electric and Hybrid-Electric Vehicles
- Building heating and cooling
- Small electric motors in everything

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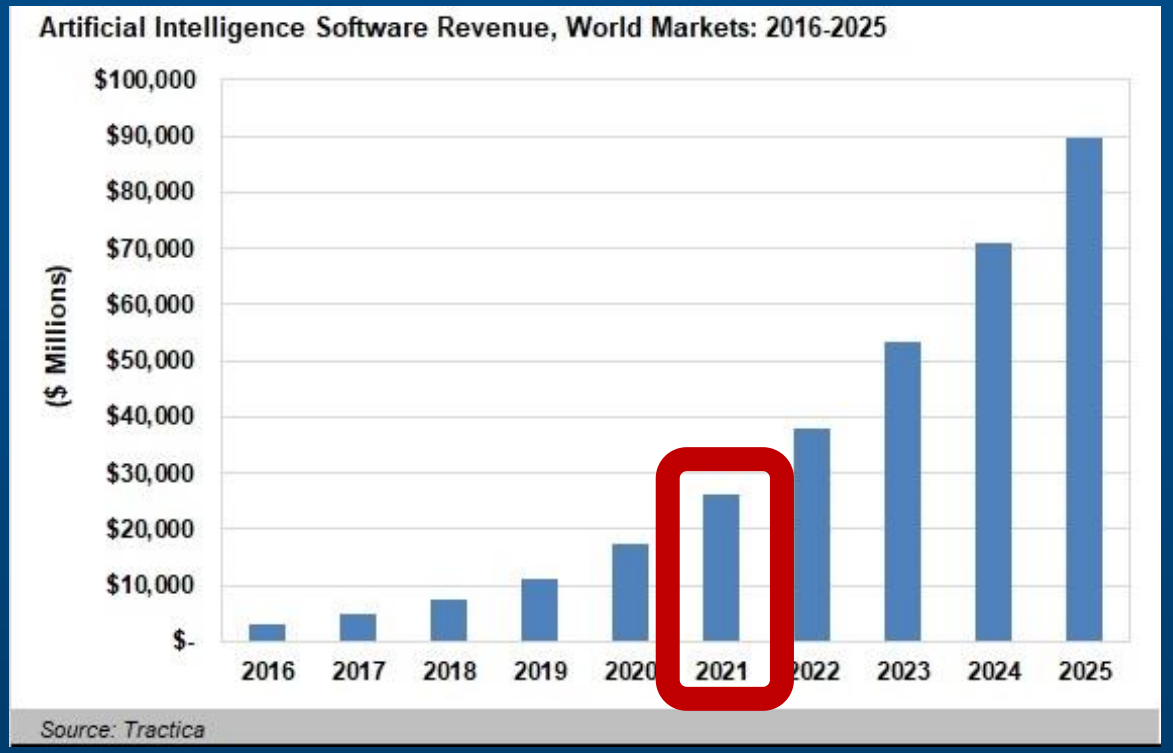
2021 MEGATRENDS

1. Software in Everything
2. Artificial Intelligence
3. Autonomous Systems
4. Digital Transformation
5. Rise of Cloud Platforms
6. Electrification of Everything



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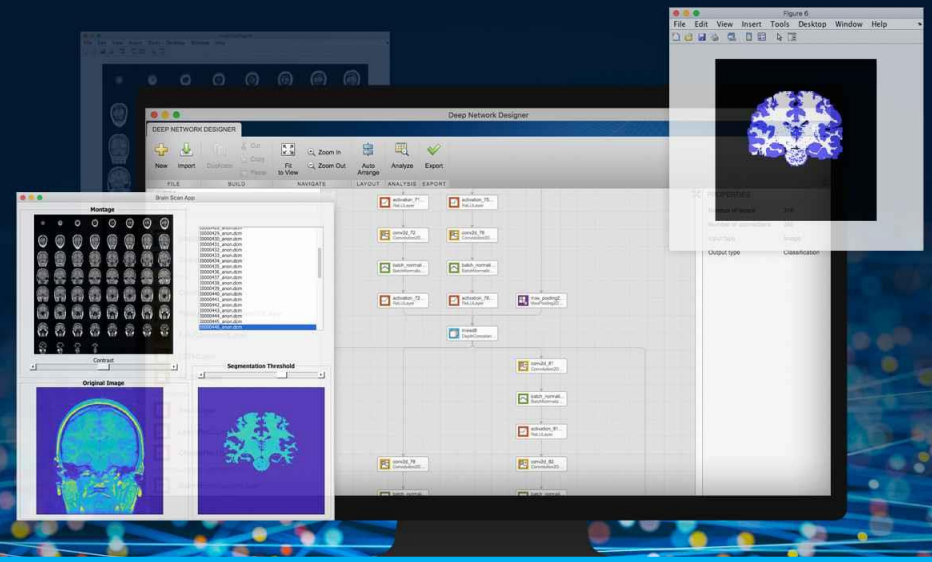

The MathWorks

MathWorks®

MathWorks Capabilities Adopted Across Industries

Aerospace and Defense

Automotive

Communications

Neuroscience

Biological Sciences

Railway Systems

Energy Production

Electronics

Medical Devices

Biotech and Pharmaceutical

Process Industries

Industrial Machinery

Semiconductors

Software and Internet

Financial Services

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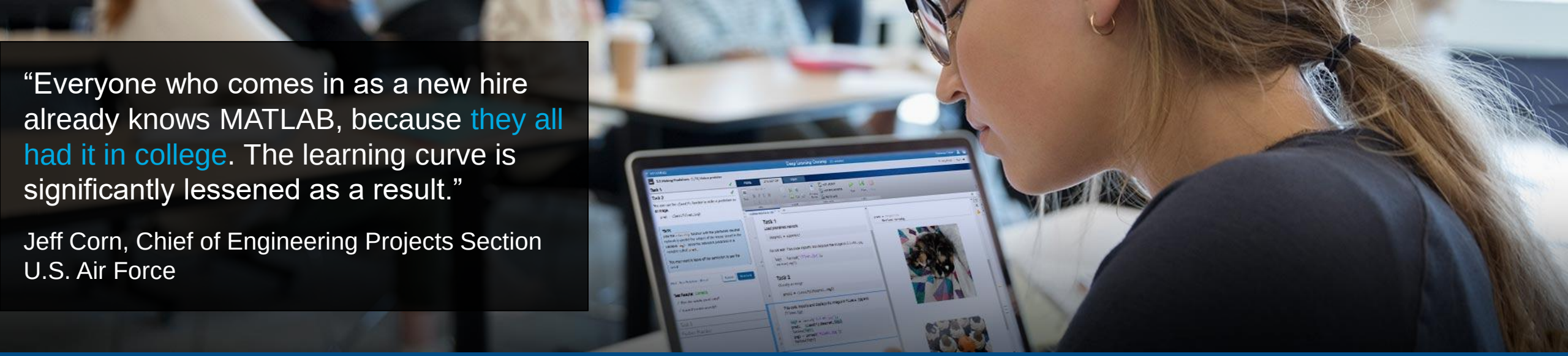

“Everyone who comes in as a new hire already knows MATLAB, because they all had it in college. The learning curve is significantly lessened as a result.”

Jeff Corn, Chief of Engineering Projects Section
U.S. Air Force

- MATLAB and Simulink are the tools of inspiration and innovation used by students, educators, and researchers around the world.

6500+

colleges and universities teach our software

2100+

MATLAB and Simulink-based books

Tens of Thousands

of skilled graduates enter the workforce each year

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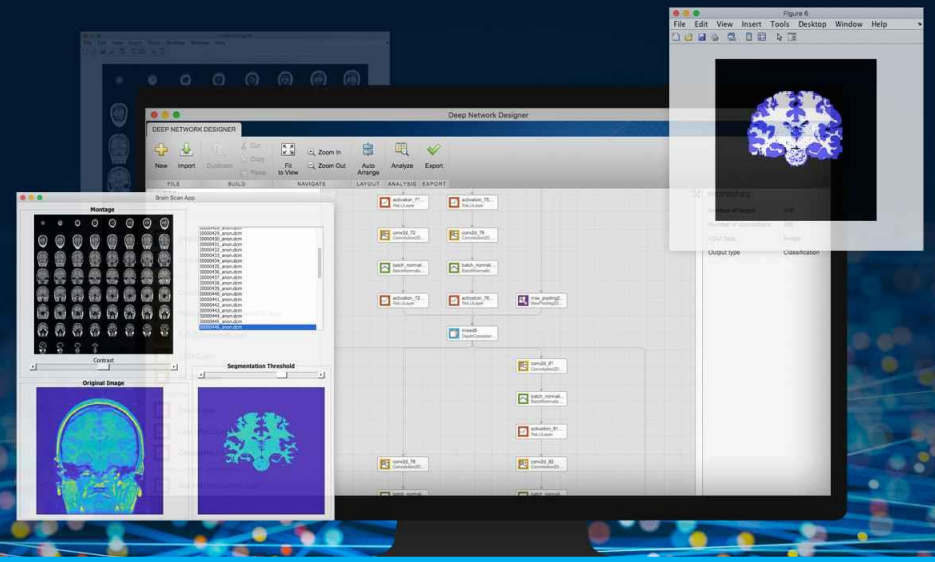

Modeling and Simulation

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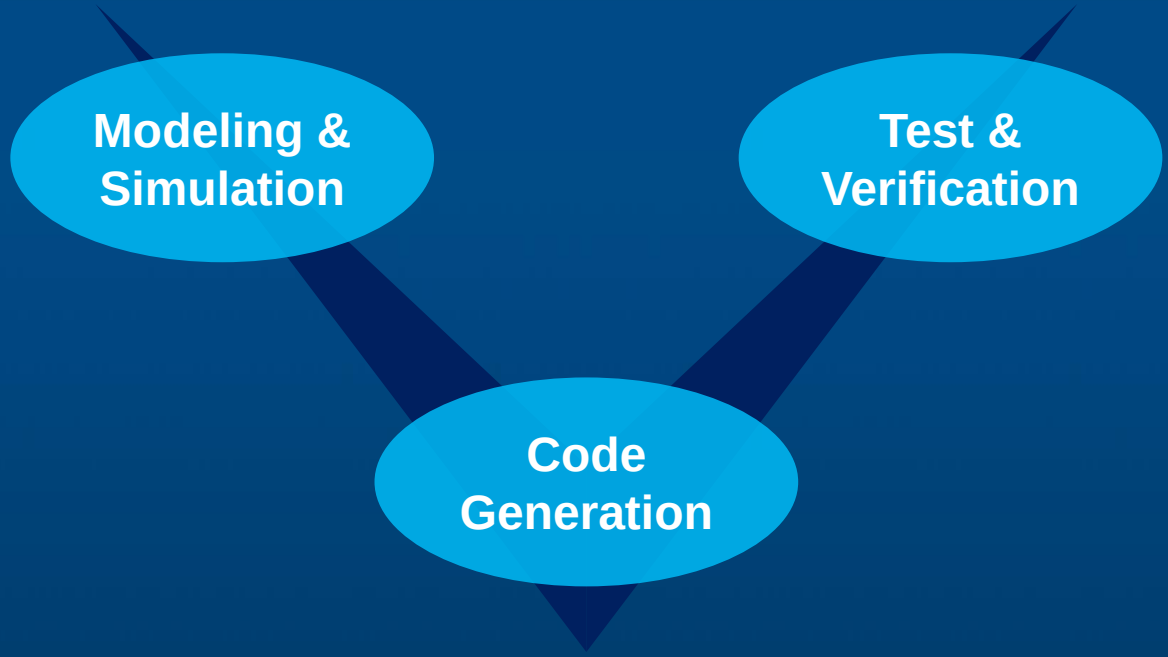
Model-Based Design



Ease-of-use

Vertical solutions

Scaling up

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Vertical solutions

MODELING & SIMULATION

Controls

Signal Processing

Wireless

Vision

Robotics

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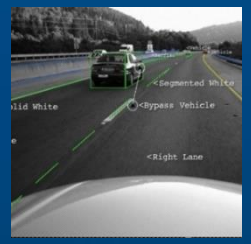
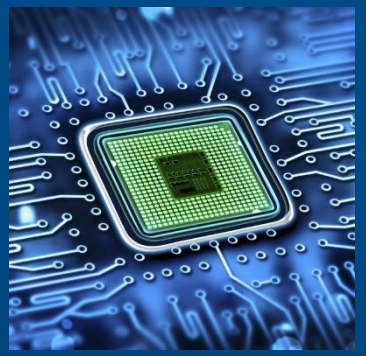
Vertical solutions

MODELING & SIMULATION



Chip Design



Mixed-Signals

Electric Motors

Motor Control

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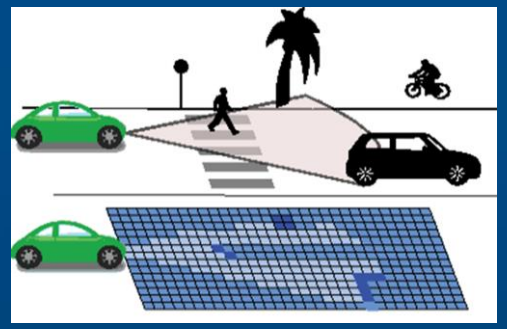
Vertical solutions

MODELING & SIMULATION

Autonomous systems

Navigation & Tracking



Sensor Fusion & Tracking
Navigation

Perception

Deep Learning
Computer Vision
Phased Array
LIDAR

Industry

Automated Driving
Robotics System
UAV

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Vertical solutions

MODELING & SIMULATION

Software Services

ROS

AUTOSAR

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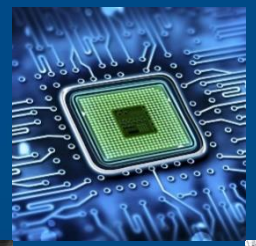
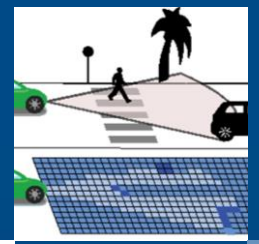
Vertical solutions

MODELING & SIMULATION

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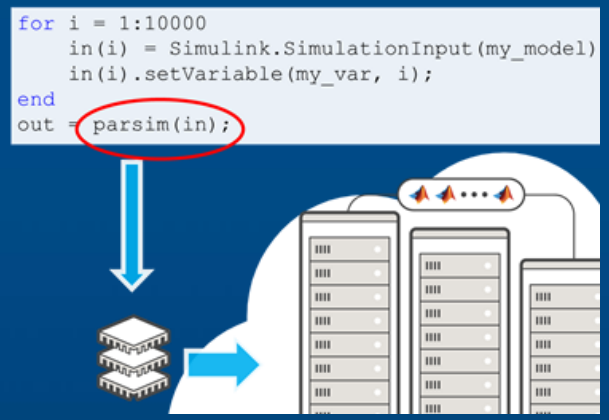
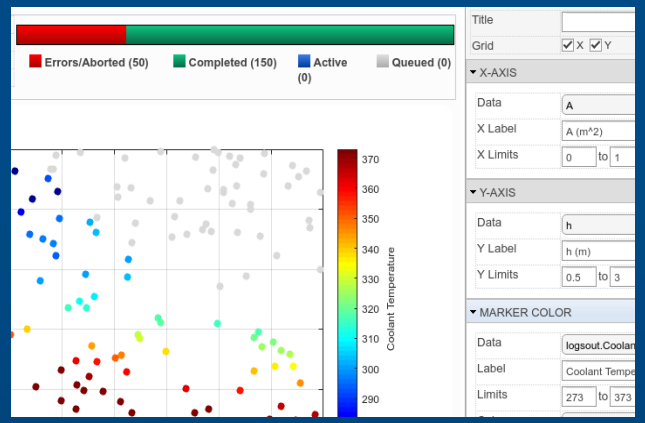
Scaling up

MODELING & SIMULATION

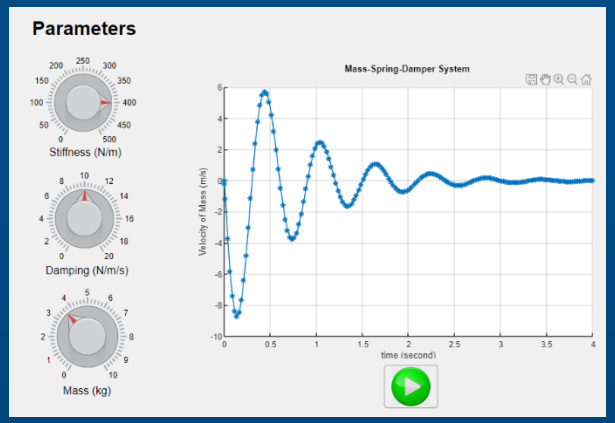
X 1,000,000's



Parallel simulations



Simulation Manager



Simulink Compiler

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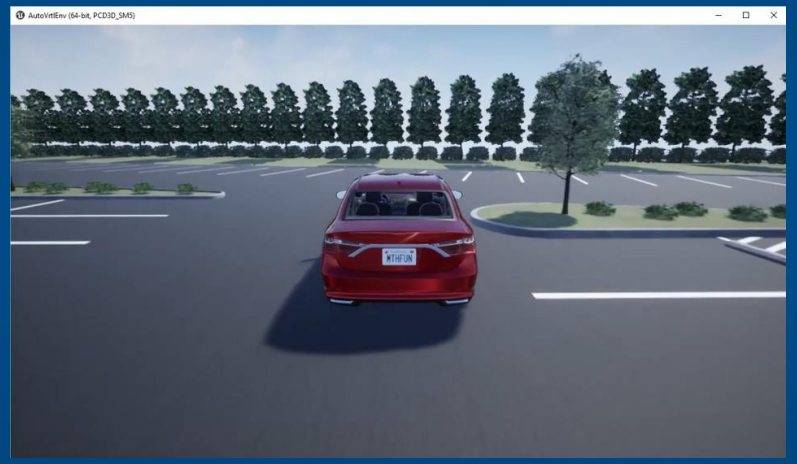

Modeling & Simulation

Code Generation

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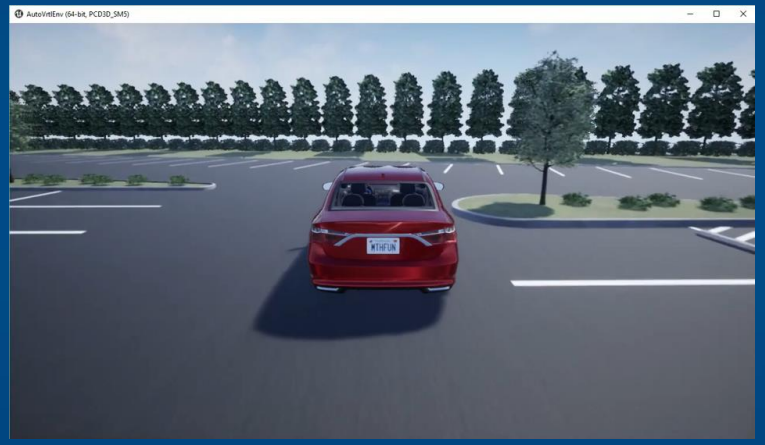

Code Generation

```
#include "AutomatedParkingValetAlgorithm.h"
#include "AutomatedParkingValetAlgorithm_private.h"

int32_T div_s32_floor(int32_T numerator, int32_T denominator)
{
  int32_T quotient;
  uint32_T absNumerator;
  uint32_T absDenominator;
  uint32_T tempAbsQuotient;
  boolean_T quotientNeedsNegation;
  if (denominator == 0) {
    quotient = numerator >= 0 ? MAX_int32_T : MIN_int32_T;

    // Divide by zero handler
  } else {
    absNumerator = numerator < 0 ? ~static_cast<uint32_T>(numerator) + 1U :
      static_cast<uint32_T>(numerator);
    absDenominator = denominator < 0 ? ~static_cast<uint32_T>(denominator) + 1U :
      static_cast<uint32_T>(denominator);
    quotientNeedsNegation = ((numerator < 0) != (denominator < 0));
    tempAbsQuotient = absNumerator / absDenominator;
    if (quotientNeedsNegation) {
      absNumerator %= absDenominator;
      if (absNumerator > 0U) {
        tempAbsQuotient++;
      }
    }

    quotient = quotientNeedsNegation ? -static_cast<int32_T>(tempAbsQuotient) :
      static_cast<int32_T>(tempAbsQuotient);
  }

  return quotient;
}

void AutomatedParkingValetModelClass::APV_emxInit_real_T(emxArray_real_T_T
  **pEmxArray, int32_T numDimensions)
```

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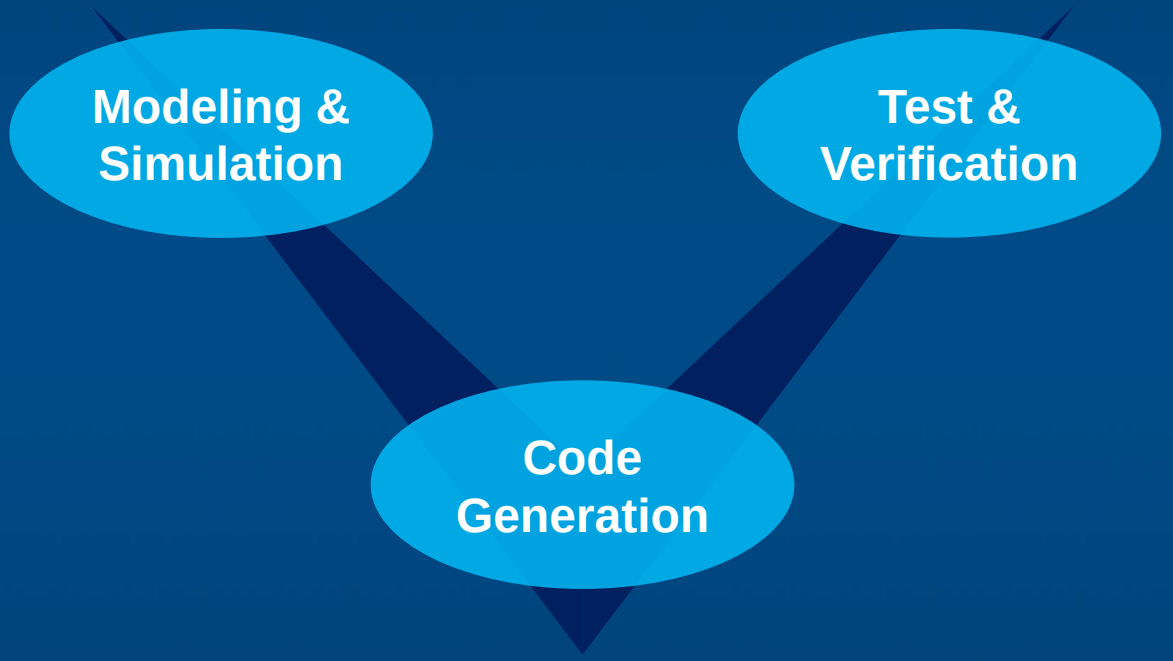

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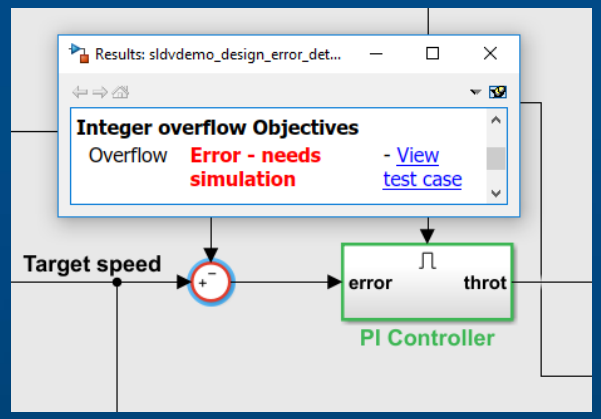
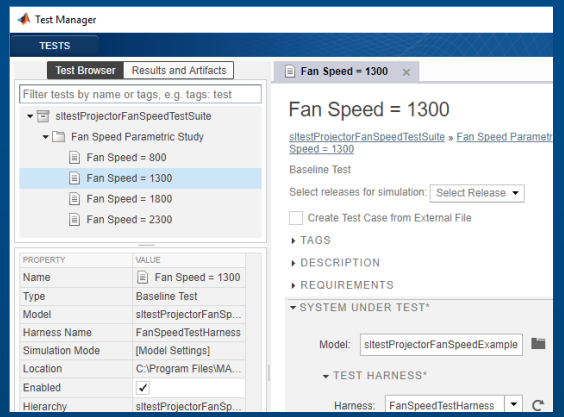
Automated Test and Verification

TEST & VERIFICATION

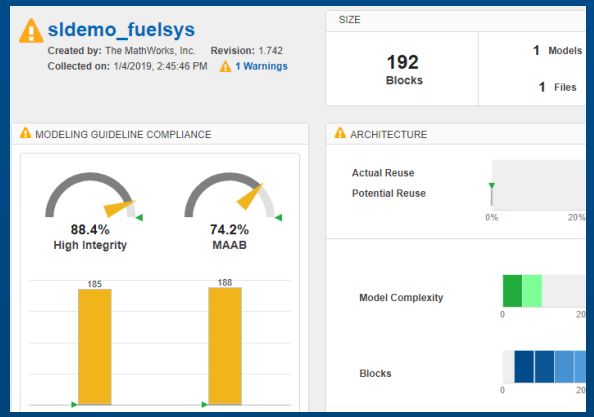
Find bugs



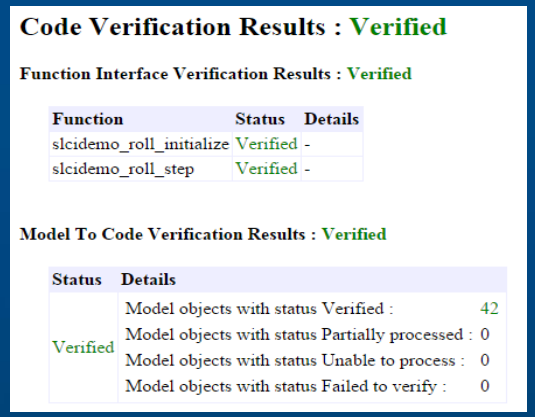
Manage tests



Check & coverage



Inspect code



Code Verification Results : Verified

Function Interface Verification Results : Verified

Function	Status	Details
slcidemo_roll_initialize	Verified	-
slcidemo_roll_step	Verified	-

Model To Code Verification Results : Verified

Status	Details	
Verified	Model objects with status Verified :	42
	Model objects with status Partially processed :	0
	Model objects with status Unable to process :	0
	Model objects with status Failed to verify :	0

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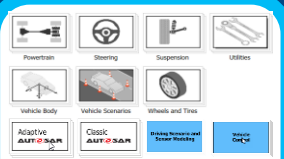
Simulink is the Simulation Integration Platform

Modeling & Simulation

MODELING & SIMULATION

Ecosystem with 100+ third-party tools and languages

DDS



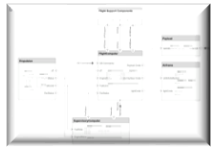
Block libraries

MATLAB

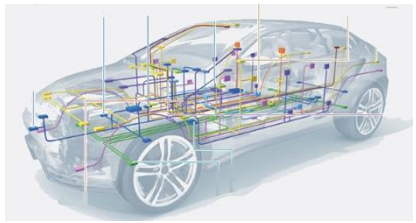
C++

fmi

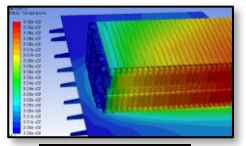
OpenCV



System architecture



Simulink



ANSYS

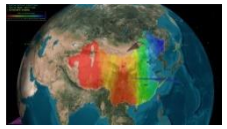
UNREAL ENGINE

NVIDIA CUDA

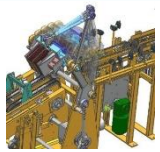
Continuous-time models | Discrete-time models | Physical models | State machines | Discrete-event models

SYNOPSYS

Virtual ECU models



AGI STK



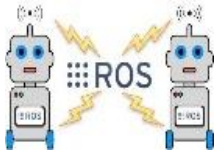
NX Motion

PHOENIX INTEGRATION

ModelCenter

PRESAGIS

HMI development



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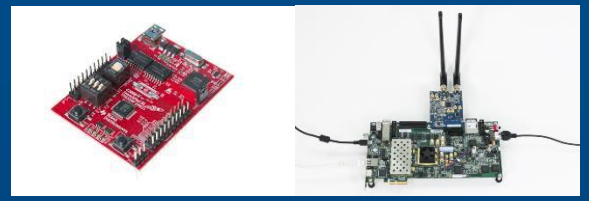
Hardware is supported across workflow

CODE GENERATION

Mass-market low cost hardware

Rapid prototyping hardware

Commercial hardware



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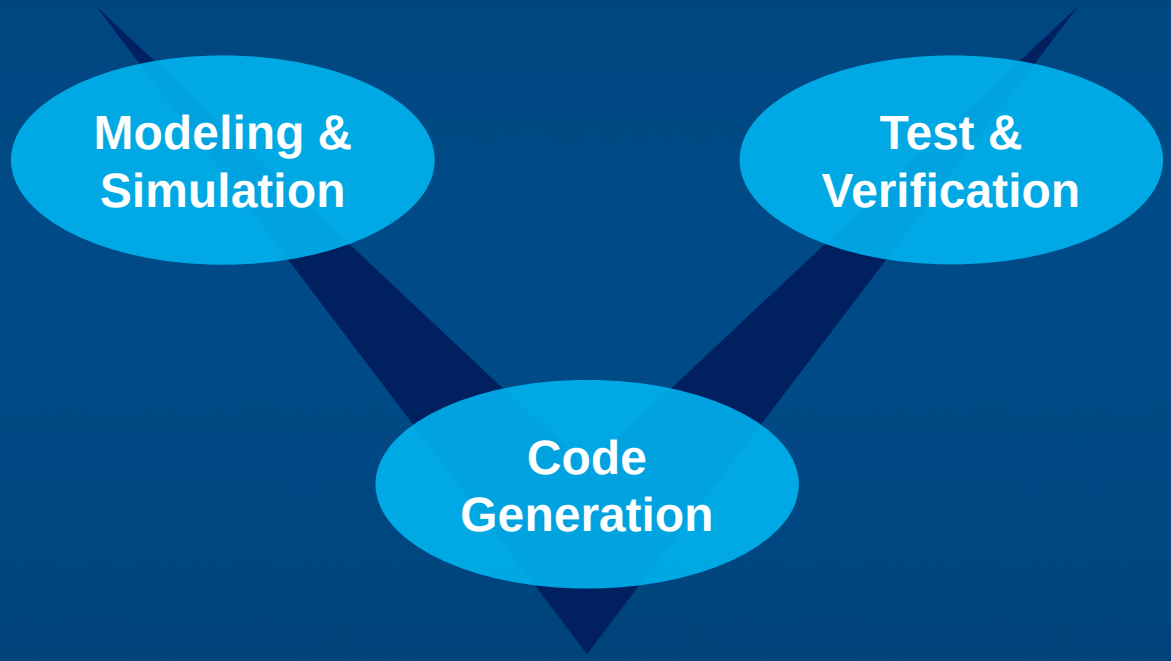

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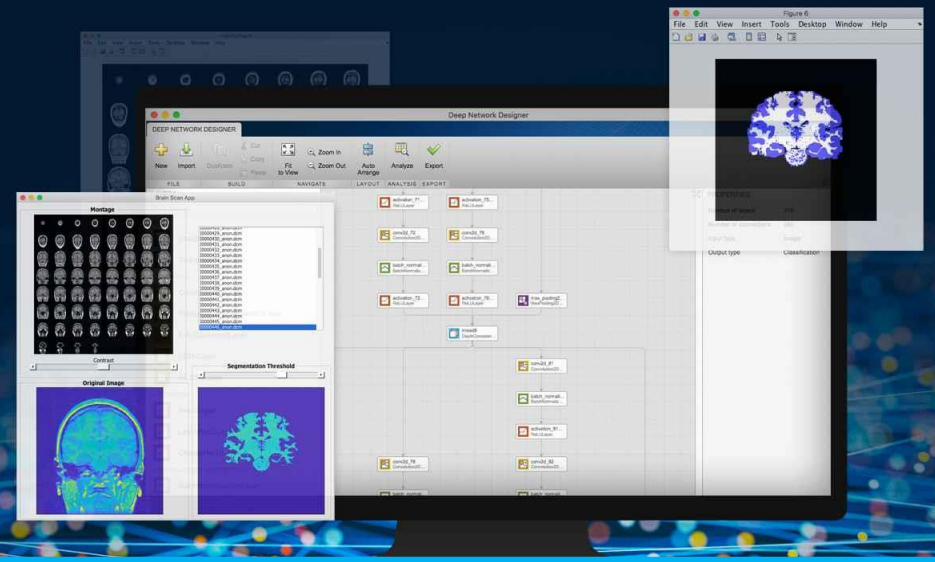
MATLAB® & SIMULINK®



The engineering platform for AI

MathWorks®

1. Data Preparation
2. AI Modeling
3. Simulation and Test
4. Deployment

MathWorks

AI-driven system design workflow

1 Data Preparation

- Data cleansing and preparation
- Human insight
- Simulation-generated data

2 AI Modeling

- Model design and tuning
- Hardware accelerated training
- Interoperability

3 Simulation and Test

- Integration with complex systems
- System simulation
- System verification and validation

4 Deployment

- Embedded devices
- Enterprise systems
- Edge, cloud, desktop

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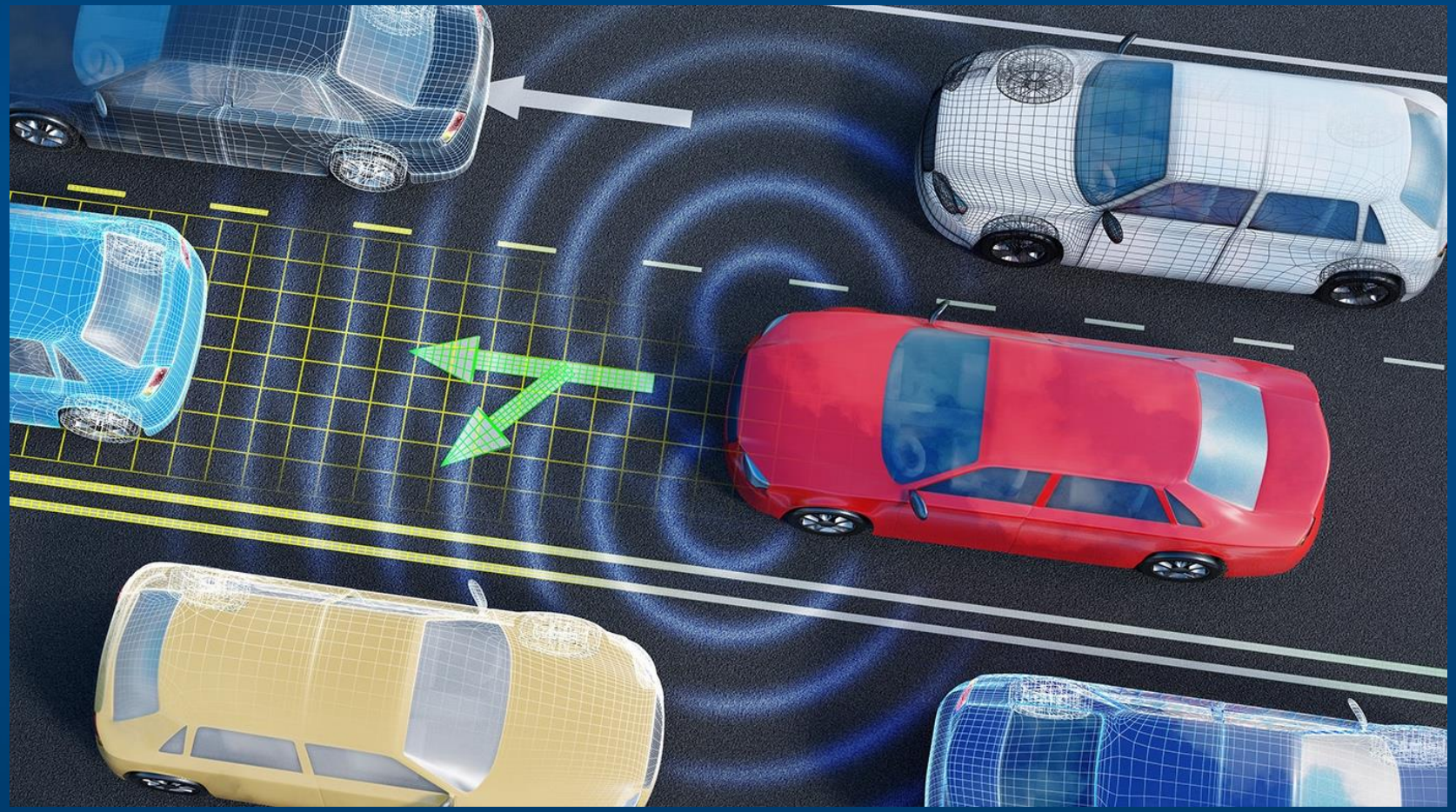
Integrate AI into system-wide context, simulate before moving to hardware, and verify effectiveness

1. Data Preparation
2. AI Modeling
3. Simulation and Test
4. Deployment



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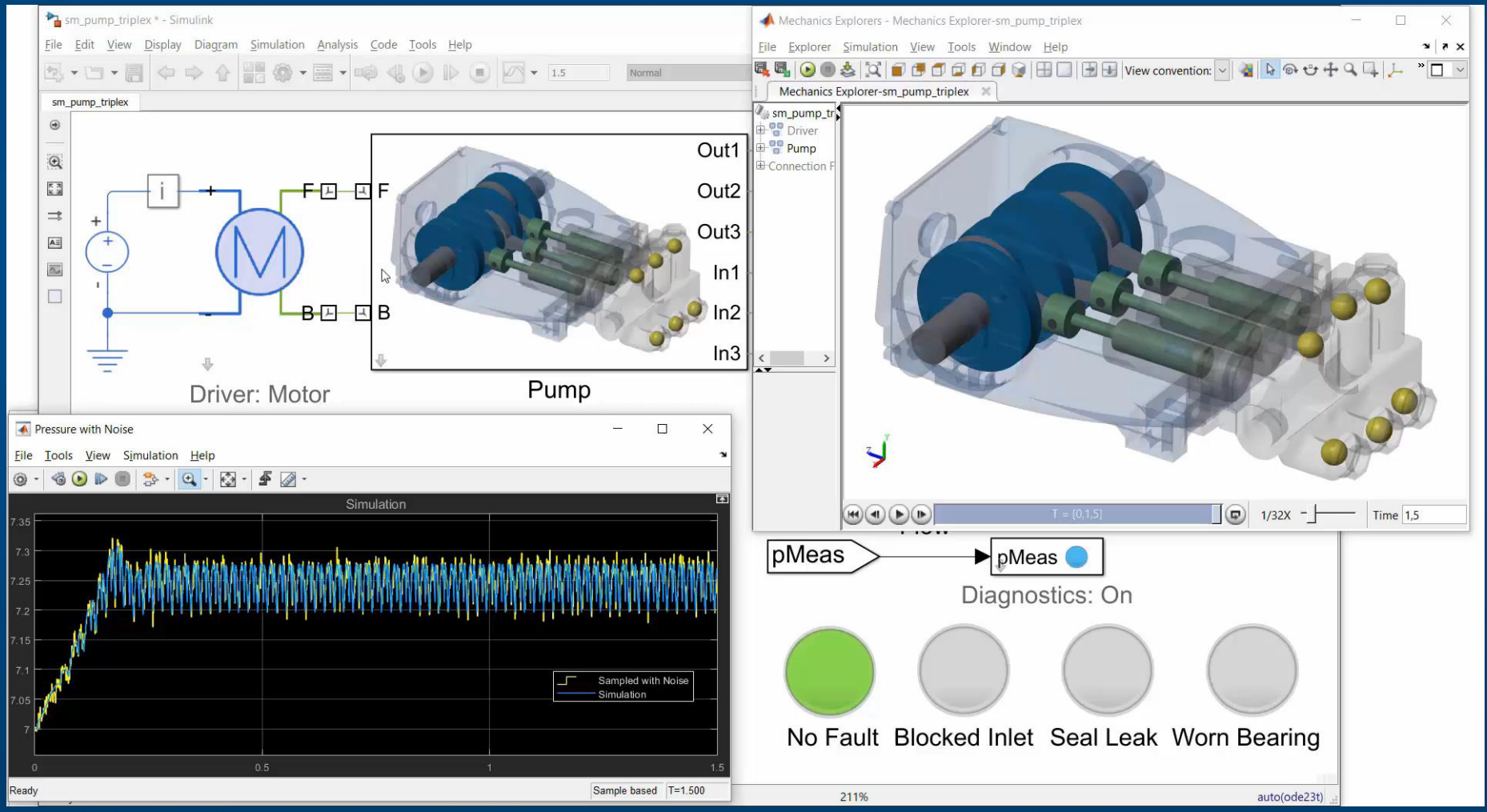
Simulate rare system failures to avoid them in the real world

1. Data Preparation
2. AI Modeling
3. Simulation and Test
4. Deployment



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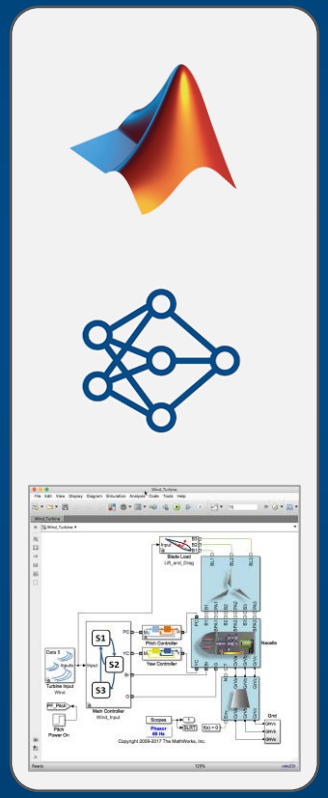
Deploy to any processor with zero coding errors

1. Data Preparation
2. AI Modeling
3. Simulation and Test
4. Deployment

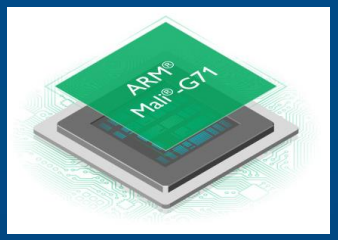


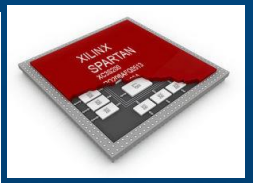
Code Generation

CPU

GPU

FPGA





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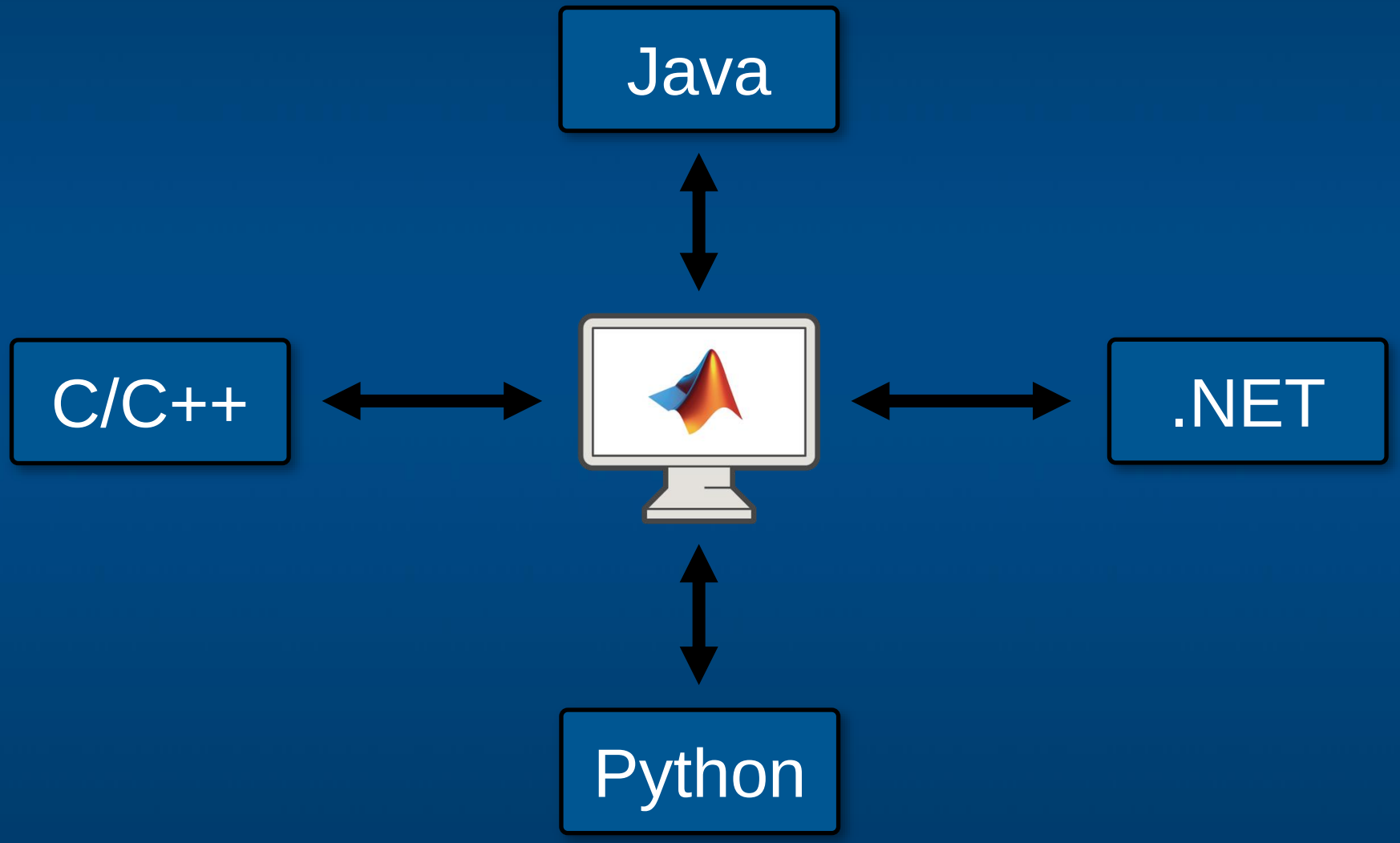
Data Access

Co-Execution

- Call Python from MATLAB
- Call MATLAB from Python

Deployment

MATLAB provides flexible integration with multiple languages



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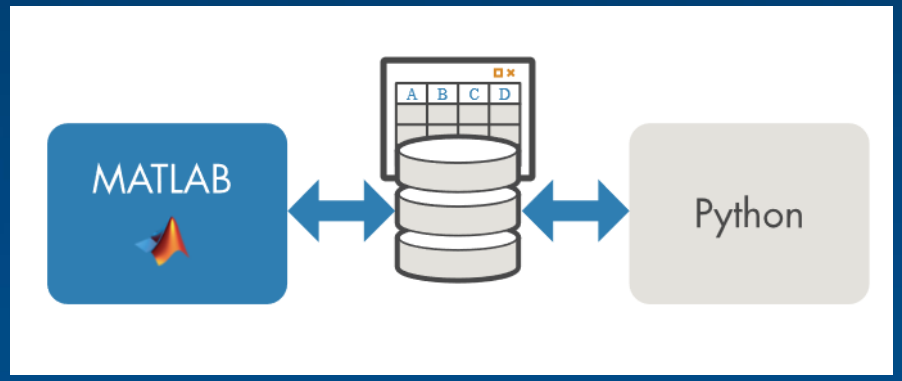
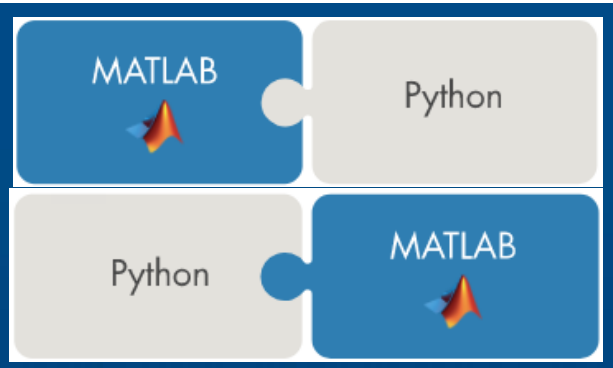
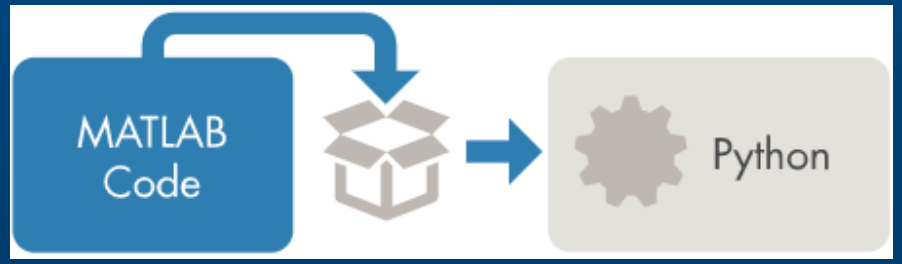
Summary: Using MATLAB with Python

- Access Data
- Interoperability
  - Calling libraries written in Python from MATLAB
  - Calling MATLAB from Python
- Deploy Apps & Algos
  - Web App
  - Production API







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Why MATLAB and Simulink for Artificial Intelligence?

- Empower domain experts, including ones with limited AI experience
- Build better data sets with domain-specific tools
- Use modeling and simulation to tackle integration challenges and reduce risk
- Deploy AI models to wherever you need them

1 Data Preparation

- Data cleansing and preparation
- Human insight
- Simulation-generated data

2 AI Modeling

- Model design and tuning
- Hardware accelerated training
- Interoperability

3 Simulation and Test

- Integration with complex systems
- System simulation
- System verification and validation

4 Deployment

- Embedded devices
- Enterprise systems
- Edge, cloud, desktop

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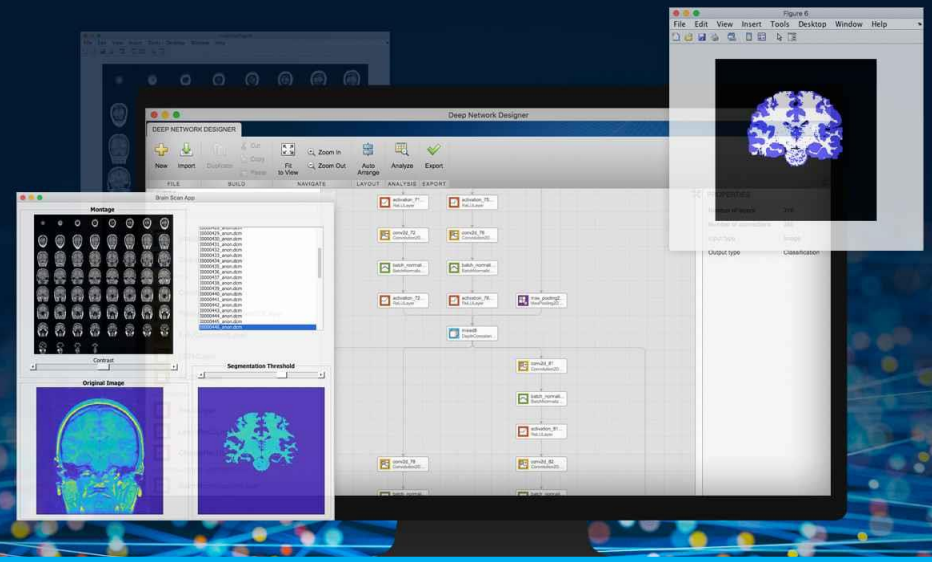

Opportunities

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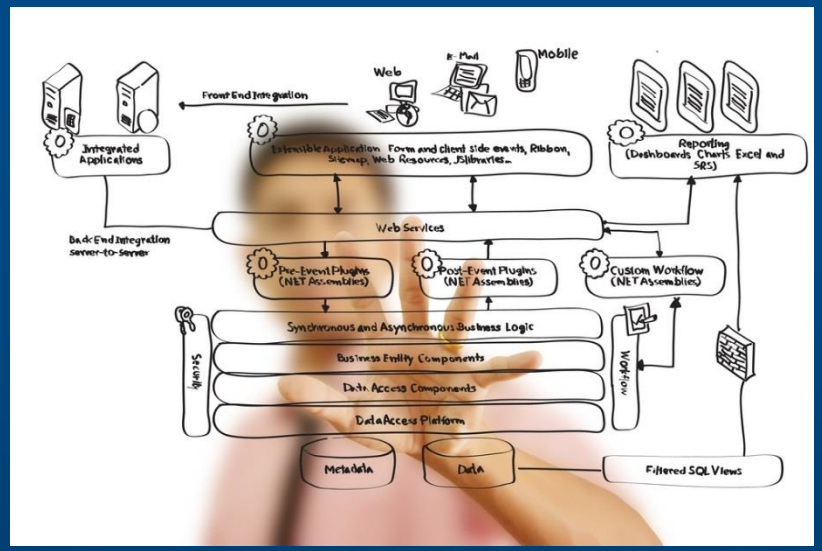
Sofware Quality Requirements

- Non-functional requirements (System Architecture) impose constraints on functional requirements (System Design)

- Specifying how a system is **supposed to be or behave**:
  - USABILITY
  - RELIABILITY
  - PORTABILITY
  - COMPATIBILITY
  - REUSABILITY
  - CONFIGURABILITY
  - AVAILABILITY
  - …



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Companies need people who know how to think…
University needs to provide companies with people who know how to think…

Business needs	Impacts
Ability to translate math models of dynamics into systems and behaviors	Core business potentially eroded
Accuracy and fidelity in models	Suboptimal performance, reduced market share
Performance in SW for tests and for deployments	No certifications: barrier to enter new markets
Systemic thinking, ability to optimize	Delays, less innovative, lost sectors
Objectives setting, Track projects, Quality concerns	Impacted communication, quality concerns
Verification & Validation	Compliancy with standards, lost markets
Standards compliancy	Potential barrier
Manage complexity properly and accurately	Lower quality products
…	…

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Where should time be invested?

AI & System theory / thinking

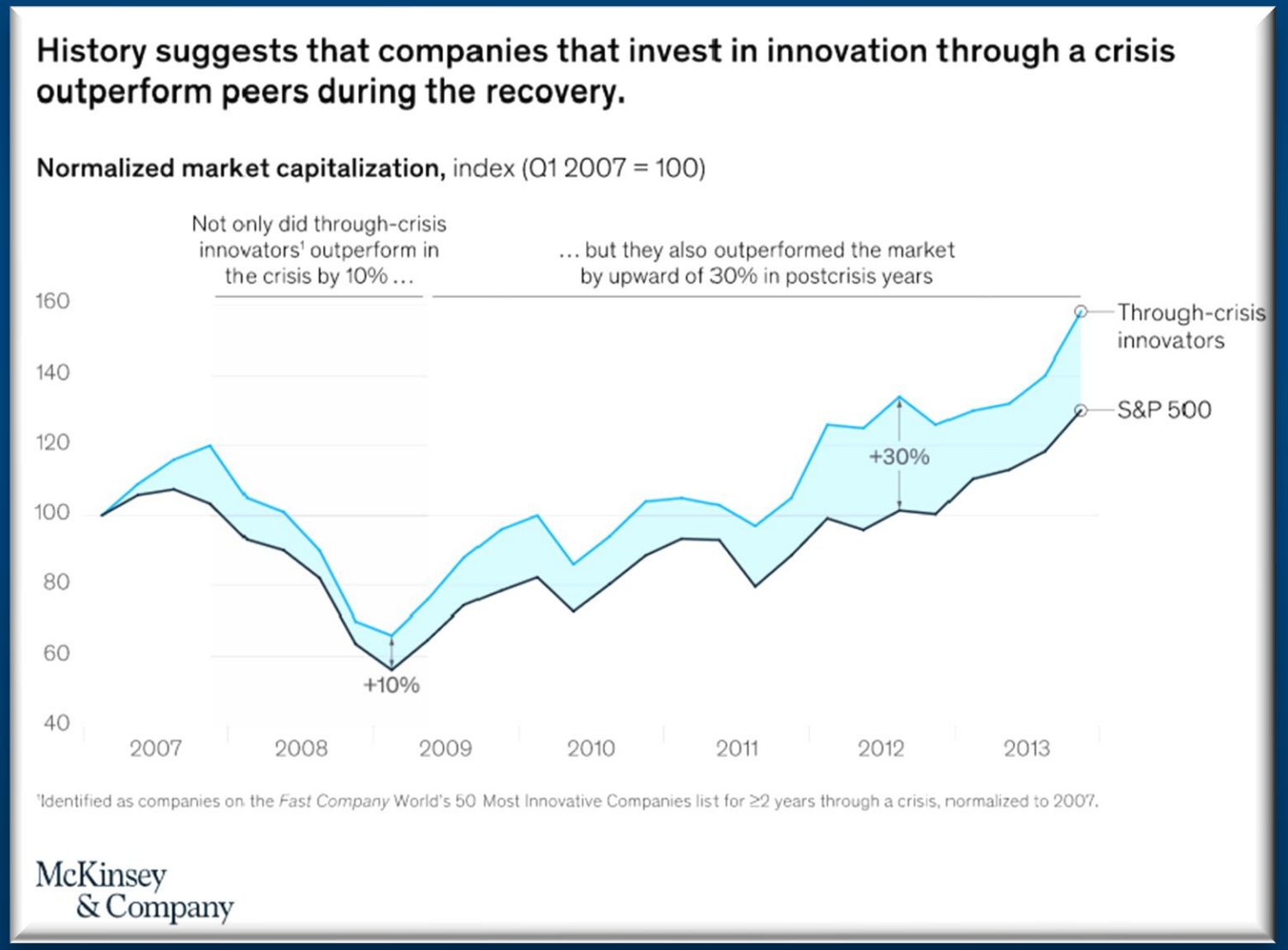
- Dynamic models
- Manage complexity
- Requirements management

Data & Test management

- Optimize Performance
- Verification & Validation
- Quality concerns

Deployment

- Automatic code generation
- Standards & certifications



An open exchange for the MATLAB and Simulink user community

A place where you can get answers, challenge yourself and others, and share your knowledge.
Tap into the knowledge and experience of over 100,000 community members and MathWorks employees.

Ask and Answer | Get & Share Code | Read and Learn | Play | Explore IoT Data

CONTRIBUTORS	ANSWERS PER DAY	DOWNLOADS PER DAY	SOLVERS PER DAY
365,000	120	25,000	730

Project-Based Learning with Low-Cost Hardware

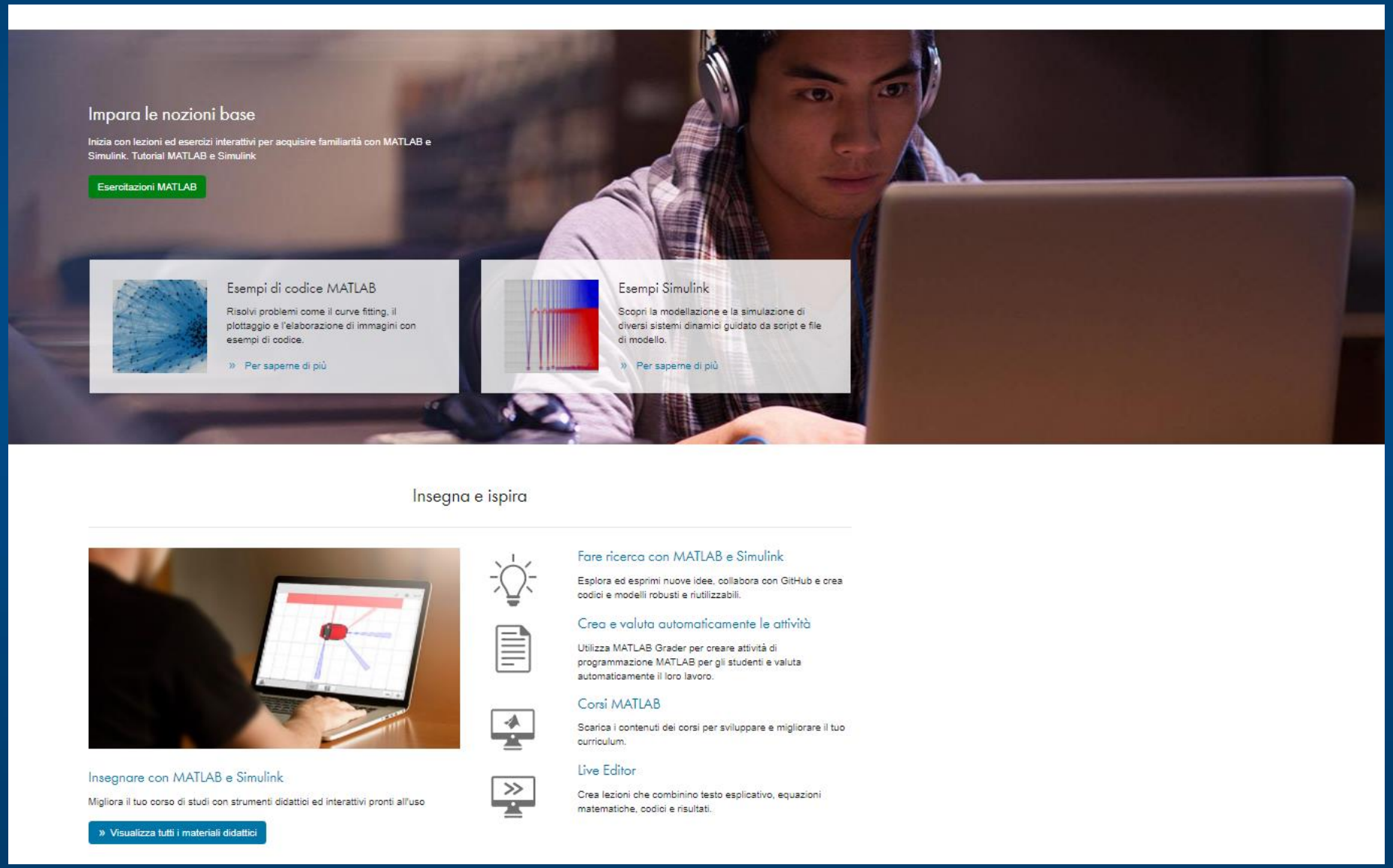
MATLAB and Simulink speak hardware

- Treat engineering students like engineers with real projects
- Easy-to-learn syntax and block diagrams
- Increase student interest and improve learning

https://www.mathworks.com/hardware-support/home.html

MATLAB for Academia

https://www.mathworks.com/academia



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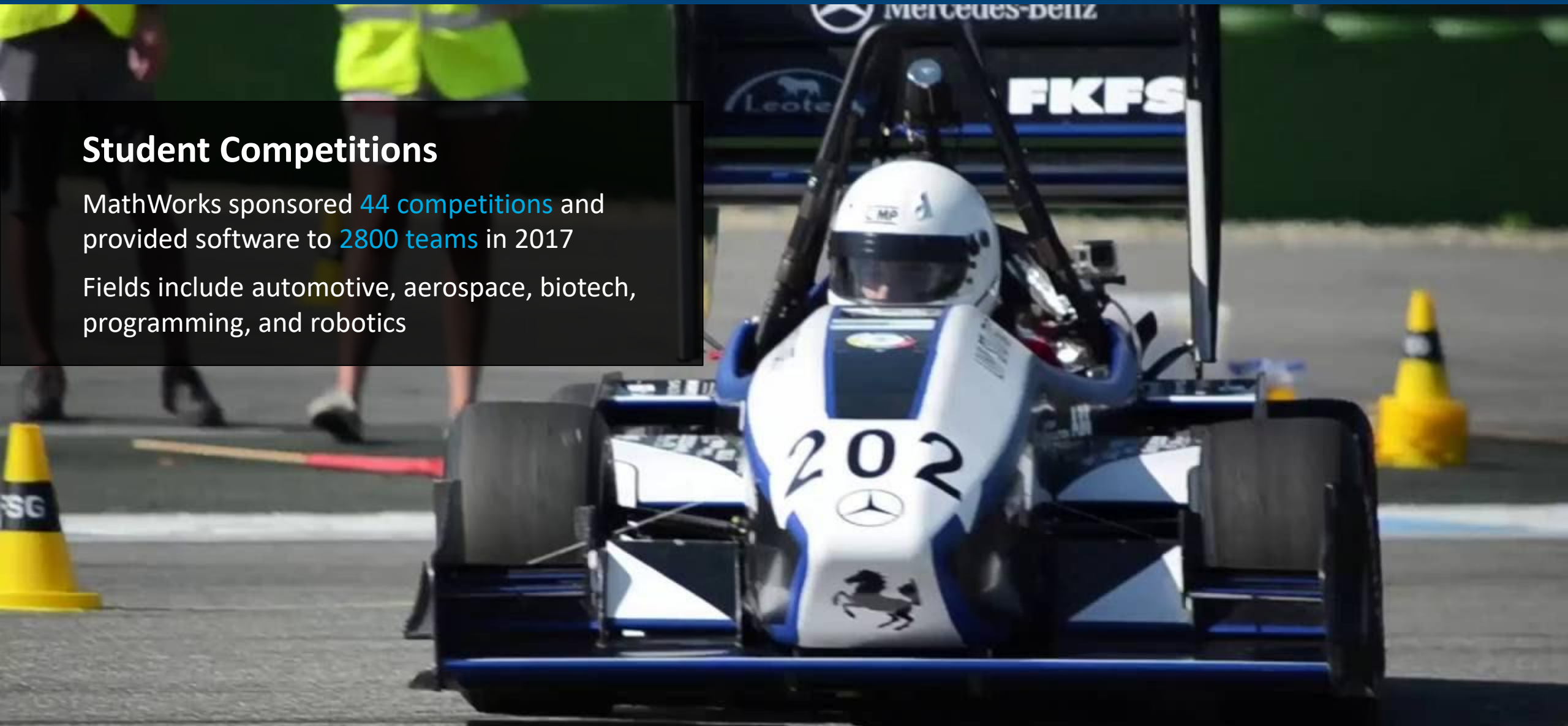
Student Competitions prepare students for careers

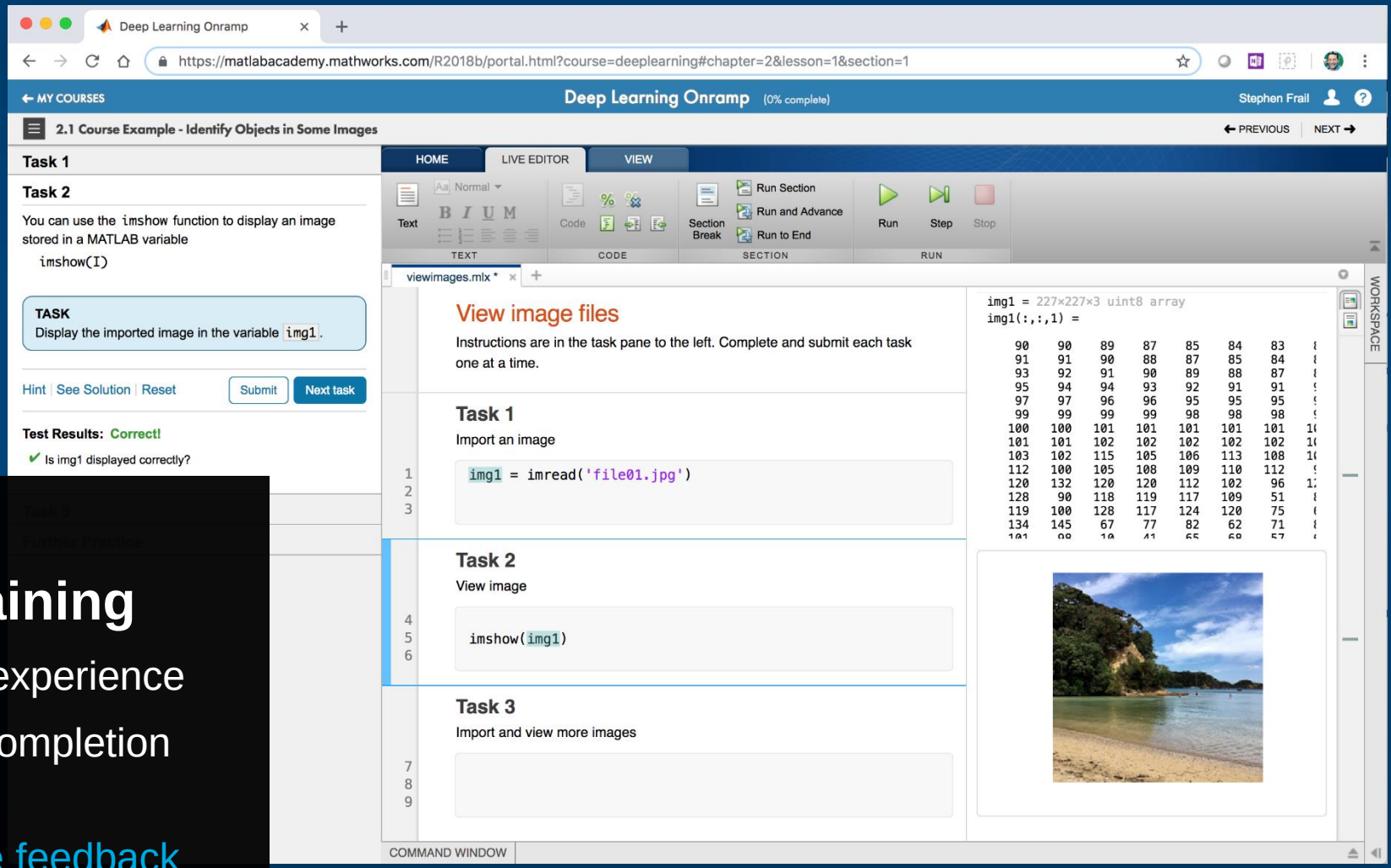


Student Competitions

MathWorks sponsored 44 competitions and provided software to 2800 teams in 2017

Fields include automotive, aerospace, biotech, programming, and robotics

Self-Paced, Online Training for MATLAB & Simulink



Campus-Wide Online Training

- Hands-on MATLAB and Simulink experience
- Measurable progress report and completion certificate
- Interactive lessons with immediate feedback
- 24/7 availability

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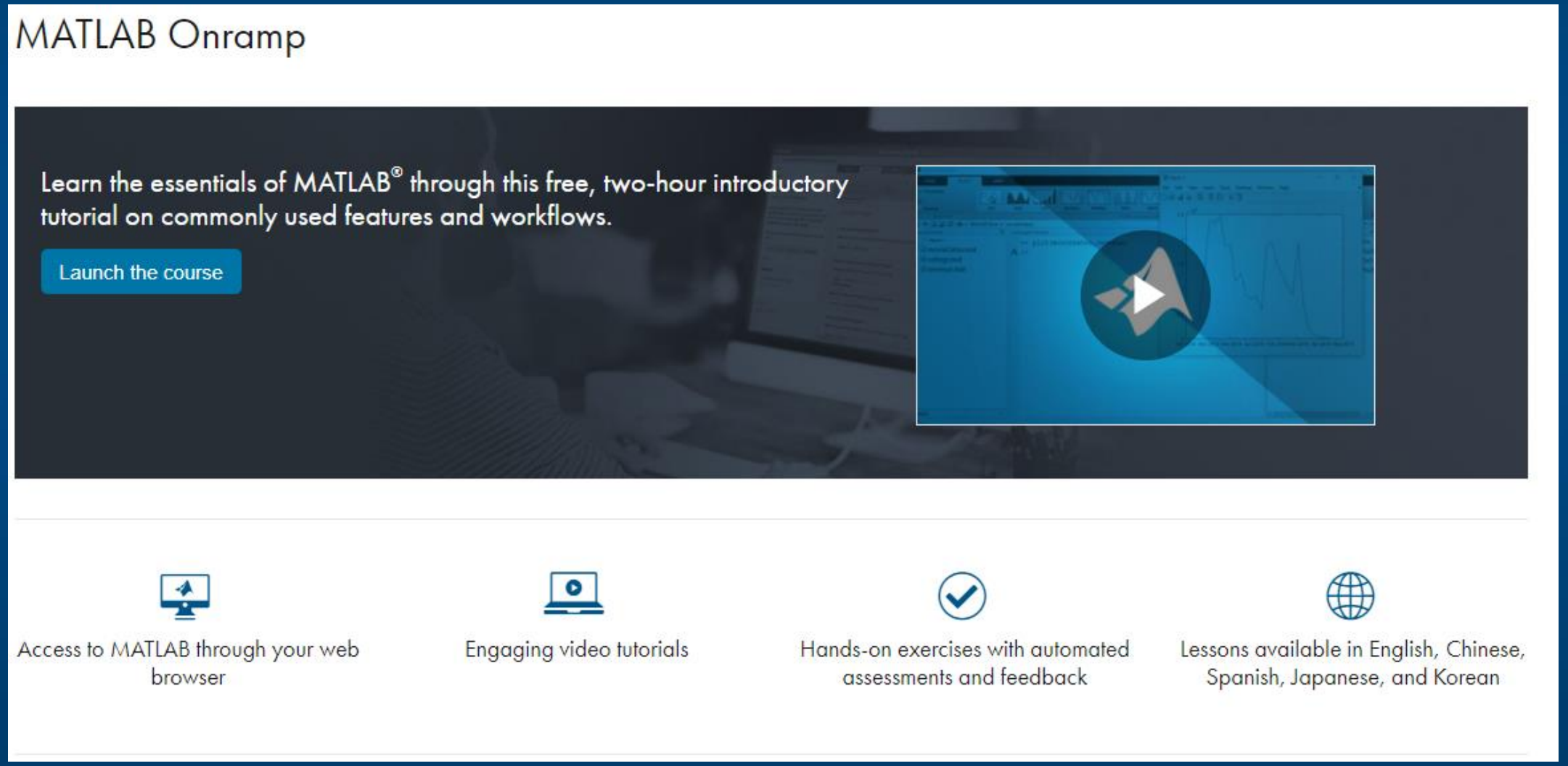
MATLAB Onramp

https://www.mathworks.com/learn/tutorials/matlab-onramp.html



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Companies Compete for better Productivity
Quality is Productivity
Quality is driven by Competence

Summary

- Companies and Business require you to…
  - Develop and invest in algorithm & systems modeling and simulation skills
  - Learn to work in Teams

- MATLAB is in these markets already, since 1984
- MATLAB is the backbone of many engineering applications
- The MathWorks is making the right investments

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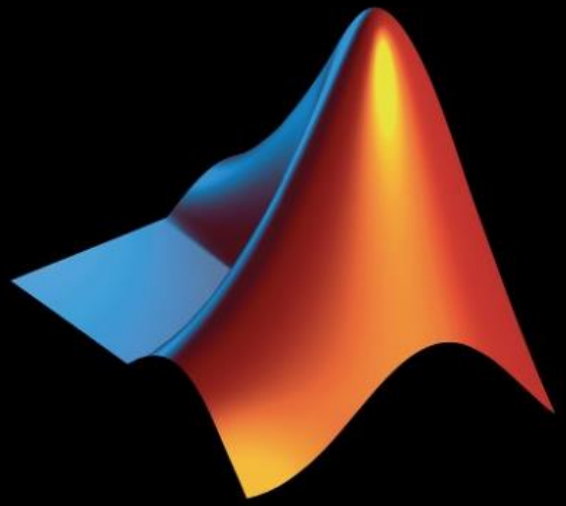

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Accelerating the pace of engineering and science

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